UNIVERSITY OF ILLINOIS

Agricultural Experiment Station

IMPERIAL BUREAU
13 JUL. 1921
OF MYCOLOGY

BULLETIN No. 213

TWO ILLINOIS RHUBARB DISEASES

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URBANA, ILLINOIS, JANUARY, 1919

Contents of Bulletin No. 213

PAGE

Rhubarb Anthracnose 299

General Character 299

The Fungus 300

Isolation 301

Culture Characters 301

Inoculations 305

Germination of Conidia 305

Taxonomy 305

Rhubarb Leaf Spot 308

The Fungus 310

Isolation 312

Culture Characters 312

Taxonomy 312

TWO ILLINOIS RHUBARB DISEASES

By FRANK LINCOLN STEVENS, Professor of Plant Pathology, University of Illinois[1]

RHUBARB ANTHRACNOSE

(Due to *Colletotrichum erumpens*)

Attention was first called to this disease on market rhubarb in the stores of Champaign during the spring of 1918. It has since been repeatedly seen in the grocery stores and has been collected in the field in numerous localities, in both cases in such abundance as to show that it constitutes a real factor in rhubarb culture.

General Character

The disease, which is of fungous origin, consists of a soft rot of the petioles. As yet no natural field infection of other parts of the plant has been seen. The decayed spots usually are soft, watery, and translucent, oval in outline, with the long axis lengthwise of the petiole (Fig. 1). When they attain a length of somewhat more than a centimeter, the black, sporulating bodies (acervuli), smaller than fly specks, appear abundantly in the centers of the spots (Fig. 2). In advanced stages the whole petiole is covered with acervuli and is entirely soft and rotten (Fig. 3).

In the market usually only the milder cases of disease are found; petioles with numerous small rotten spots which have escaped the notice of the grower when preparing his product for sale. In the field, often all old petioles lying dead on the ground are thickly covered with acervuli, and older petioles slightly wilted are heavily infected. In general this disease appears much more abundantly on old plant parts than on fresh, vigorous parts, tho many vigorous, salable petioles are attacked, as is clearly evident from the abundance of the disease in the market as well as in the field.

This disease has been collected at Champaign and Urbana, Champaign county; at Kankakee and Bourbonnaise, Kankakee county; and near Anna, Union county; and is apparently of quite general occurrence.

The injury done is threefold. Even a small amount of the disease in a bunch of market rhubarb practically destroys the possibility of selling the bunch to a careful purchaser. In the field many petioles

[1]Assisted in the laboratory and in illustrating by Nora E. Dalbey.

otherwise salable must be discarded on account of the rot. The premature death of infected petioles and consequently of the leaf blades lessens the general strength of the plant.

THE FUNGUS

The rotten spots are uniformly occupied by a species of Colletotrichum, and in early stages of decay by this fungus alone. Young, watery, translucent spots which have not yet developed acervuli show the diseased tissue quite fully occupied by the mycelium. This mycelium is hyaline and of somewhat characteristic appearance in that

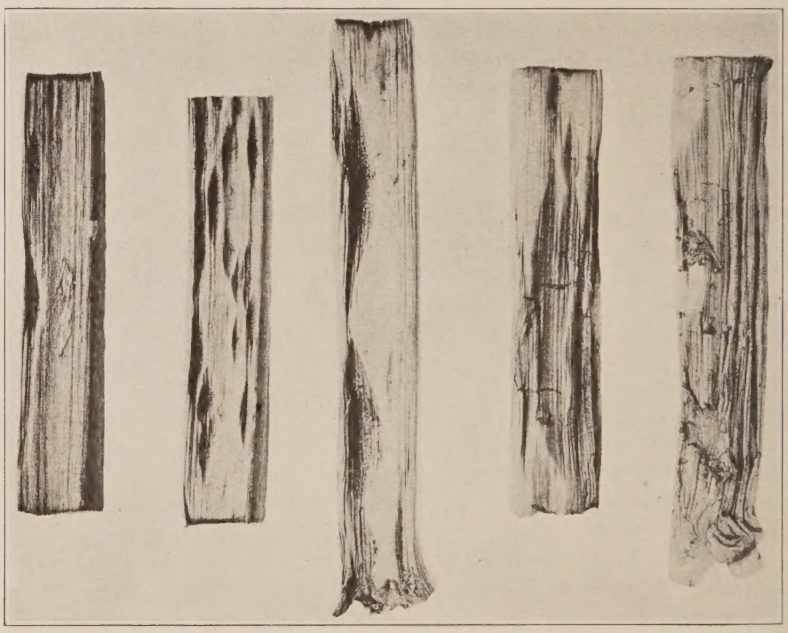

FIG. 1.—PETIOLES OF RHUBARB SHOWING VARIOUS STAGES OF DECAY RESULTING FROM COLLETOTRICHUM

the older parts are rather coarse (4 μ), conspicuously septate, and constricted at the septa (Fig. 4). Younger threads of mycelium are smaller, tapering to 2 μ at the extremities.

The acervuli begin subcuticularly as an aggregate of hyphae, Fig. 5 (1), which soon ruptures the cuticle. When mature they are circular or oval and of an average diameter of about 200 μ. Soon after rupturing the cuticle, one or more setae appear, and in the mature acervulus the setae are numerous, usually from fifteen to

Fig. 2.—A single spot, enlarged. The minute pustules are the acervuli

twenty or more Fig. 5 (2, 3). Spores begin to form as soon as the cuticle ruptures, and the mature, undisturbed acervulus is covered with a mound of spores, often so deep as to cover even the tips of the setae.

The setae are black, somewhat pale at the tip, usually 3- or 4-septate, upward of 150 μ long, and about 7 μ thick at base, and with an acute tip, Fig 6 (1, 2).

The conidia are falcate (Fig. 7), quite uniform in size, measuring 22 to 29 μ by 3.5 μ, hyaline and continuous, and acute at each end. The conidiophores are shorter than the conidia, simple and continuous.

Isolation

The fungus was readily isolated by several of the usual methods:

1. By dilution platings of spores. In many cases the plates were entirely pure, with hundreds of colonies of the Colletotrichum.

2. By differential growth, by direct planting of bits of infected tissue upon poured corn-meal agar plates. When this method was employed, the Colletotrichum outgrew its contaminators, and could thus be easily isolated.

3. By direct planting of spores from drops of sterile water upon poured agar plates. The colonies so secured on corn-meal agar did not produce normal acervuli, but they did eventually produce characteristic conidia, and when transferred to sterile rhubarb gave abundant normal acervuli.

Culture Characters

On corn-meal agar plates the mycelium showed a tendency to darken in some cases, producing many filaments almost black, and giving to all the colonies a dark appearance. Analysis shows that the darkening of the colonies is due to an excessive production of ap-

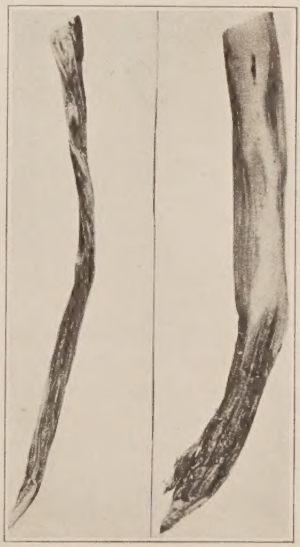

Fig. 3.—Advanced stages of decay of the rhubarb petioles

pressoria[1] and of structures which are morphologically appressoria. Often these are produced in large numbers in clumps which appear as black sclerotia-like bodies, several millimeters in diameter. This was particularly true where two colonies approached each other in the plate (Fig. 8). The structure of the component parts of such a spot is represented in Fig. 6 (3). A general view of several colonies on corn-meal agar is shown in Fig. 8. On this medium the acervuli are produced somewhat sparsely, after an interval of about a week.

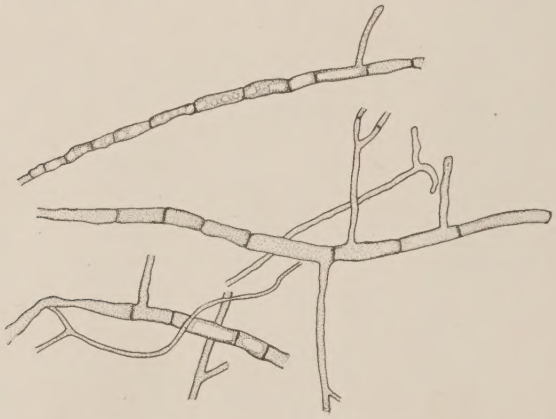

FIG. 4.—CHARACTERISTIC BRANCHING AND SEPTATION OF THE COLLETOTRICHUM MYCELIUM

When sterile (autoclaved) rhubarb was laid upon poured plates of corn-meal agar and then inoculated with the fungus, acervuli formed much more quickly than upon corn-meal agar alone, and spores were produced in much greater quantity. Thus abundant mature acervuli were present upon the bits of rhubarb at the end of three days.

Bits of rhubarb petioles were cut aseptically, and placed on poured corn-meal agar plates. Upon these growth was as upon the autoclaved rhubarb but decidedly more vigorous.

Corn-meal agar was poured into plates, then inoculated. When the colonies attained a diameter of about a centimeter, bits of raw, aseptic rhubarb were laid on the agar about a centimeter from the edge of the colony, in order to see whether the growth rate in this sector of the colony would be altered by the rhubarb. No such effect was noticeable, but it was found that tho the fungus made acervuli

[1]Hasselbring, H. Bot. Gaz. 42, 135, 1906; and Halsted, B.D., N.J. Agr. Exp. Sta. Rpt., 1892, 303.

but very sparsely on the agar it did make them abundantly upon the bits of raw rhubarb upon the agar.

On various autoclaved plugs the fungus grew well: e.g., on *Rumex crispus,* with typical acervuli but growth rather slow; on *Rumex acetosella,* similarly but growth more vigorous; on *Polygonum erectum* growth was scant and acervuli small; on *Polygonum lapathifolium* growth was similar to that on *Polygonum erectum* but slightly more vigorous; on Tropœolum stems, growth was very rapid and acervuli

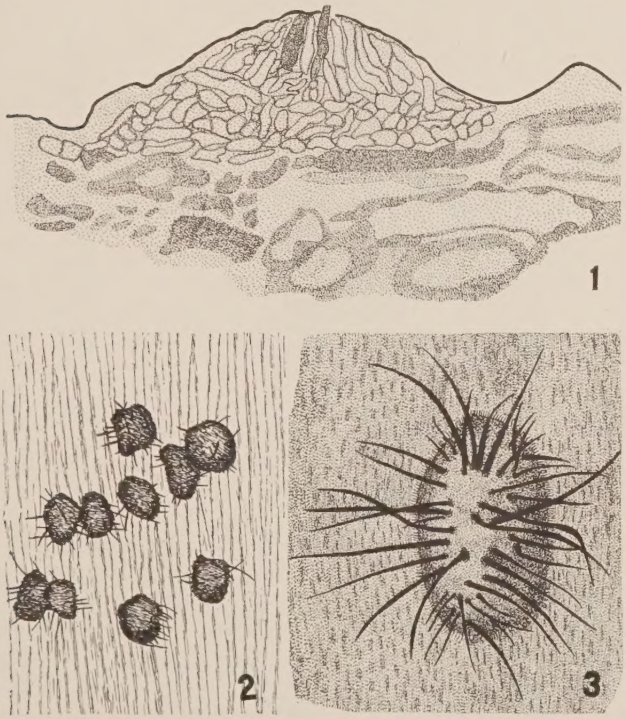

FIG. 5.—(1) A VERY YOUNG ACERVULUS; AN AGGREGATE OF MYCELIUM BELOW THE CUTICLE WITH INDICATIONS OF BEGINNINGS OF SETAE. (2) TYPICAL GROUP OF ACERVULI. (3) A TYPICAL ACERVULUS

numerous, showing these stems to be more favorable than any other medium.

On cabbage plugs the whole culture was less dark than on rhubarb plugs, the floccose aerial mycelium was white, and there was almost entire absence of appressoria, and of sclerotia, or other dark structures except those of the acervuli, which were very abundant and normal.

On rice there was an unusually large production of appressoria and sclerotia, giving the culture a striking black character (Fig. 9). In tubes on autoclaved rhubarb plugs, growth was vigorous, the surface of the plugs becoming closely covered with acervuli which produced spores about a week after inoculation. In the older portions

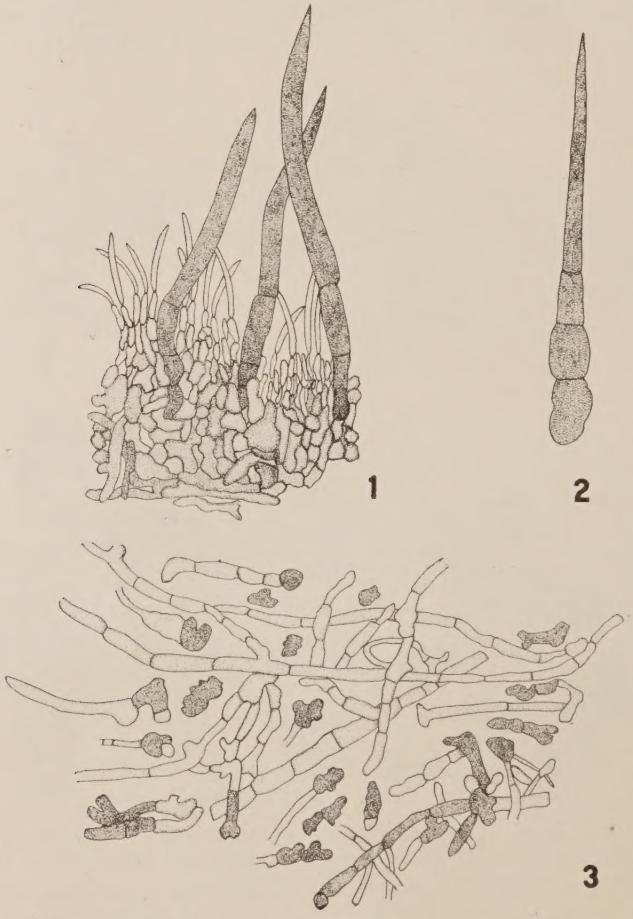

FIG. 6.—(1) DETAIL OF SETAE AND CONIDIOPHORES. (2) A SINGLE SETUM. (3) COMPONENT PARTS OF THE SCLEROTIA-LIKE BODIES PRODUCED IN AGAR PLATES

the plugs were covered by a thin growth of aerial mycelium. On corn-meal agar in slant tubes the surface of the slant soon became covered with black sclerotia-like structures, and a ring of these structures was formed wherever the fungus touched the glass.

Inoculations

When spores from diseased tissue, or fragments of diseased tissue, or mycelium from a pure culture were inoculated into rhubarb petioles, the typical rot rapidly followed.

Tho the disease was not found in the field upon leaf blades, laying the spores upon leaf blades in a moist chamber in the laboratory resulted, in about seven days, in large, rotten, leaf spots bearing numerous typical acervuli. The disease also often appeared thru natural infection on leaf blades in the laboratory.

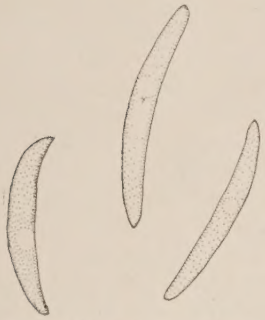

Fig. 7.—Spores of Colletotrichum

Germination of Conidia

Germination in water in hanging drop gave the usual characters of the anthracnose fungi; i.e., the spores usually became two-celled, developed a germ tube from one or both cells, and often from the germ tubes one or more appressoria (Fig. 10).

TAXONOMY

The fungus is a typical Colletotrichum. Never were setae absent from mature acervuli, nor is there any basal tubercular structure which would throw it into the genus Volutella. Colletotrichum as

FIG. 8.—TYPICAL COLONIES ON CORN-MEAL AGAR
LEFT: FOUR COLONIES RIGHT: MANY COLONIES
A dark line due to sclerotia-like bodies is evident in all cases when one colony meets another.

Fig. 9.—Growth of Colletotrichum on autoclaved rice

given by Saccardo[1] contains 113 form species. Of these, however, only 33 have falcate spores. There are 83 species of Volutella listed by Saccardo. The falcate-spored Colletotrichums are given in the accompanying table, together with such of the closely related genus Volutella as have falcate spores.

From this tabulation have been omitted such forms as are described as having spores "straight or slightly curved," "straight or curved," or similarly designated, on the assumption that such are not typically falcate, a character which were it present would be sufficiently obvious to be mentioned.

Accepting the descriptions as correct, Nos. 1 to 27 inclusive and Nos. 29, 38, and 43 do not agree in spore size with the fungus under consideration. Nos. 44 to 47 inclusive need not be considered. Nos. 28, 30 to 37, and 39 to 42 are so close in spore measurements to the species causing the rhubarb rot, that this might indeed, on that basis alone, be considered as co-specific with any one of them; nor is there any evidence from measurements of setae, except in the case of No. 37, that would bar such an assumption. Close inspection of the specific descriptions eliminates Nos. 40 and 41, which are clearly tubercular.

There then remains a group consisting of ten species which from the descriptions are indistinguishable from each other and from the

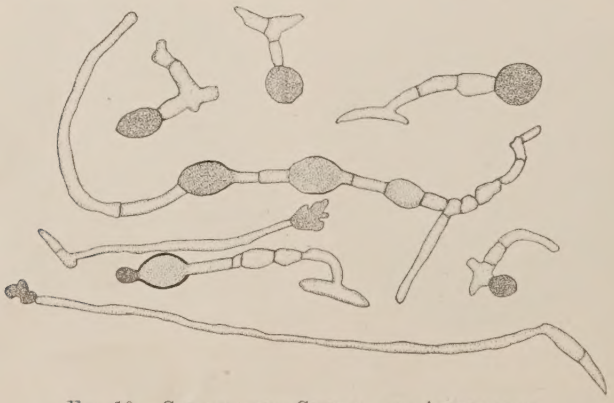

FIG. 10.—GERMINATING CONIDIA AND APPRESSORIA

[1]Saccardo, Sylloge Fungorum.

FALCATE-SPORED FORMS OF COLLETOTRICHUM AND VOLUTELLA

Arranged in order of maximum spore length (μ)

No.	Saccardian Vol.	Saccardian No.	Name	Spore Length×Breadth	Setae Length×Thickness	Host
1	4	3234	*V. chalybea*	7–8×4–5	115–140×2.3	"fimo"
2	11	3676	*C. sanguisorbae*	9–10×2–2.5	80–100×3–6	Sanguisorbia
3	10	6851	*C. sphaeriaeforme*	10×3[1]	.....	Menispermum
4	4	3237	*V. buxi*	10–11×3–4	100–120×4	Buxus
5	14	4026	*C. yuccae*	13×3.5	60×6	Yucca
6	10	6846	*C. pisi*	11–13×3–4	60– 90×6	Pisum
7	14	4019	*C. solitarium*	12–14×2.5–3	65– 75×2–3	Solidago
8	4	3227	*V. comata*	12–14 ×	.....	Robinia
9	18	5034	*C. liliaccarum*	12–17×2.5–3.5	70×5–5.5	Hemerocallus
10	16	3885	*C. piri*	13–18×3.5–5.5	.....	Pirus
11	3	3843	*C. volutella*	14–18×2.5–3.5	300×5–6	Ulmaria
12	4	3263	*V. therryana*	15–18×3	150×1	Grasses
13	18	5014	*C. theobromicolum*	15–18×4–5	.....	Theobroma
14	16	3882	*C. violae-tricoloris*	20×5	20– 70×	Viola
15	18	5772	*V. tristis*	11–20×2	400×7–8	Erica
16	10	6852	*C. spinaciae*	14–20×2.5–3	60– 75×4–4.5	Spinacia
17	16	3886	*C. elasticae*	16–20×4.5–5	200–250×	Ficus
18	10	6854	*C. gloeosporioides*	18–20×5–6	.....	Hedera
19	16	4258	*V. violae*	15–21×3–4	.....	Viola
20	4	3244	*V. fusarioides*	18–21×2–3.5	60– 72×5–7	Citrus
21	16	4262	*V. allii*	18–21×3–4	60–175×6	Allium
22	10	6847	*C. carpophilum*	16–22×2.5–4	60–100×5–6	Astragalus
23	22	7733	*C. ampelinum*	17–22×4–5	.....	Vitus
24	16	3883	*C. rhoinum*	20–22×4–4.5	150–180	Rhus
25	22	7767	*C. vermicularia*	20–22×4	80– 90×4	Bromus
26	11	3679	*C. ailanthi*	22×4–5	90–135×5–9	Ailanthus
27	22	7741	*C. fructus* (*V. fructus*)	17–23×2.5–3.5	100–400×5–8	Pirus
28	10	6845	*C. brassicae*	19–24×	.....	Brassica
29	22	7763	*C. sublineola*	15–25×4–5	30– 50×7	Sorghum
30	22	7744	*C. hedericola*	17–25×3.5	140×7	Hedera
31	3	3842	*C. erumpens*	25×5	150×4	Ruscus
32	11	3683	*C. falcatum*	25×4	100–200×4	Saccharum
33	22	7732	*C. vitis*	21–25×2.5	140–160×6–9	Vitis
34	22	7768	*C. cereale*	18–26×3–4	60–120×6–8	Grasses
35	11	3681	*C. omnivorum*	20–28×3–5	.....	Funkia, Aspidistra, etc.
36	22	7753	*C. platani*	25–28×3–5	200	Platinus
37	3	3844	*C. lincola*	25–28×3.5–4	60×3	Andropogon, Umbellifers
38	22	7765	*C. antarcticum*	15–30×3–4	30–100×4–6	Poa
39	18	5025	*C. fici-elasticae*	20–30×3–4	200×6	Ficus
40	14	4493	*V. acalyphae*	25–30×2–3	150–210×4–7	Acalypha
41	14	4494	*V. oxyspora*	25–30×2–3	100–150×4–5	Beta
42	18	5036	*C. andropogonis*	30×4	100–150×8	Andropogon
43	22	7766	*C. janczewskii*	24–34×3–6	70–150×4	Poa
44	4	3245	*V. isabellina*	.....	.....	Salix
45	4	3232	*V. pulchella*	.....	.....	Branches
46	4	3252	*V. melaloma*	.....	.....	Carica
47	4	3226	*V. georginae*	.....	.....	Georgina

[1]Spuriously 2 to 3 septate.

species described in this paper. These are designated as follows, from their oldest species, as the—

Colletotrichum erumpens group:

No. 31. *Colletotrichum erumpens* Sacc.
28. *C. brassicae* Schulz and Sacc.
35. *C. omnivorum* Hals.
32. *C. falcatum* Went.
39. *C. fici-elasticae* Zimm.
33. *C. vitis* Ist.
42. *C. andropogonis* Zimm.
30. *C. hedericola* Laub.
34. *C. cereale* Manns
36. *C. platani* Da Camara

In the present condition of knowledge concerning these forms, and until monographic work is completed regarding them, it seems wise to assume that the rhubarb Colletotrichum belongs to this group, and tentatively to refer to it as *Colletotrichum erumpens.*

RHUBARB LEAF SPOT

(Due to *Phyllosticta straminella*)

This disease was first collected at Bourbonnaise, Kankakee county, Illinois, where it was in great abundance in one field. Nearly every leaf in the plantation was affected with many spots, often occupying considerably more than half of the leaf area. A general idea of the

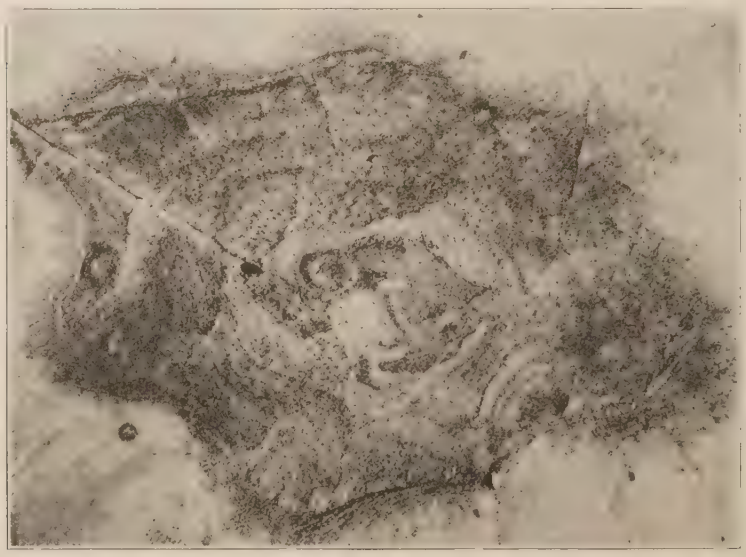

FIG. 11.—A SINGLE DISEASED SPOT OF THE PHYLLOSTICTA DISEASE ON RHUBARB

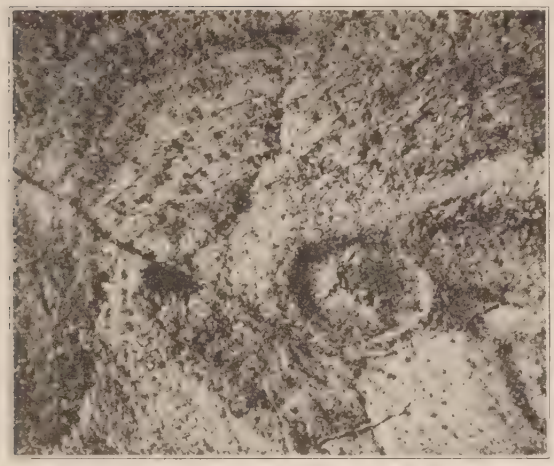

FIG. 12.—AN ENLARGED VIEW OF A PORTION OF THE SPOT SHOWN IN FIG. 11
The pycnidia are here clearly shown.

nature of the effect upon the leaf is given in the front-cover illustration. More detail of a single spot is shown in Fig. 11. Unlike the preceding disease this is not preeminently a disease of old leaves but even the comparatively young leaves may be seriously spotted. While mainly affecting the leaf blade, it has also been found upon the petioles. Upon the leaf blade the chief character is the irregularly circular dead spot, varying from a few millimeters up to several centimeters in diameter. The dead area is tan color and often dry and cracked or torn (see front cover). The margin of the spot is definite, with a rather sharp limitation between diseased and healthy tissue. Close inspection shows numer-

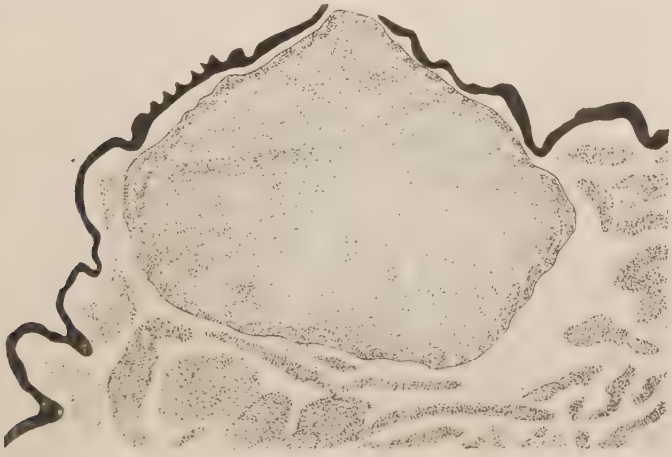

FIG. 13.—PHYLLOSTICTA. A PYCNIDIUM IN SECTION, SHOWING SUBCUTICULAR DEVELOPMENT AND SHAPE OF THE PYCNIDIUM
The cavity was entirely filled with spores.

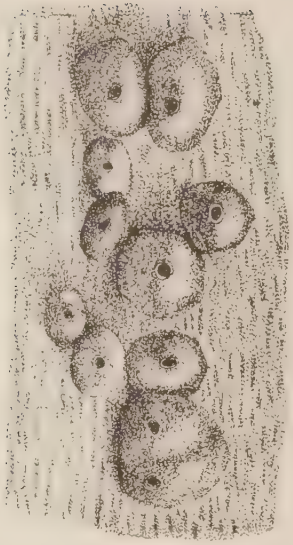

Fig. 14.—Phyllosticta, Pycnidia viewed from above

ous very minute dark pustules (pycnidia) (Figs. 11 and 12). On petioles and stems the spots are oval lengthwise of the petiole, distinctly sunken, and quite dry. Sometimes a spot extends for nearly the whole length of a petiole, occupying perhaps only one side or part of one side of it.

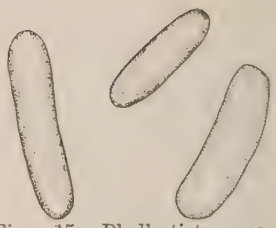

Fig. 15.—Phyllosticta spores from a leaf spot

Fig. 16.—Phyllosticta spores, small type

In addition to collections at Bourbonnaise, others have also been made at Urbana, Kankakee, and Champaign. Specimens collected at Ladoga, Indiana, in 1916, by Dr. P. J. Anderson and at Racine, Wisconsin, by M. W. Gardener, bear the same fungus. When prevalent to the extent shown in the cover illustration, and to that degree on many leaves, as is the case in some fields, the drain on the vigor of the plants must be large.

The Fungus

Microscopic examination invariably revealed the presence of a pycnidial fungus of the Phoma or Phyllosticta type. Fig. 12, an en-

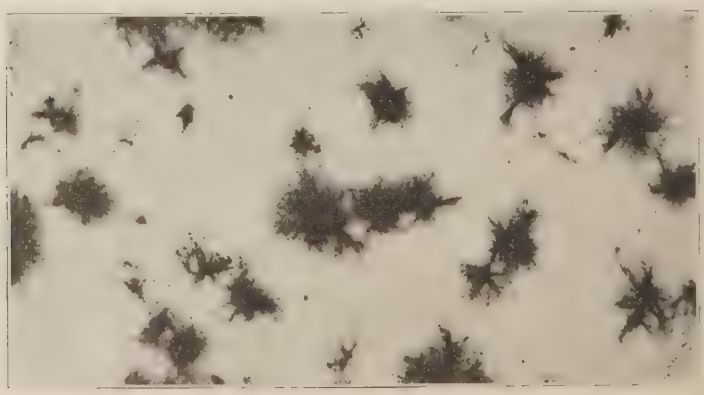

FIG. 17.—PORTION OF PETRI DISH SHOWING PHYLLOSTICTA COLONIES
This plating was made direct from rhubarb leaves.

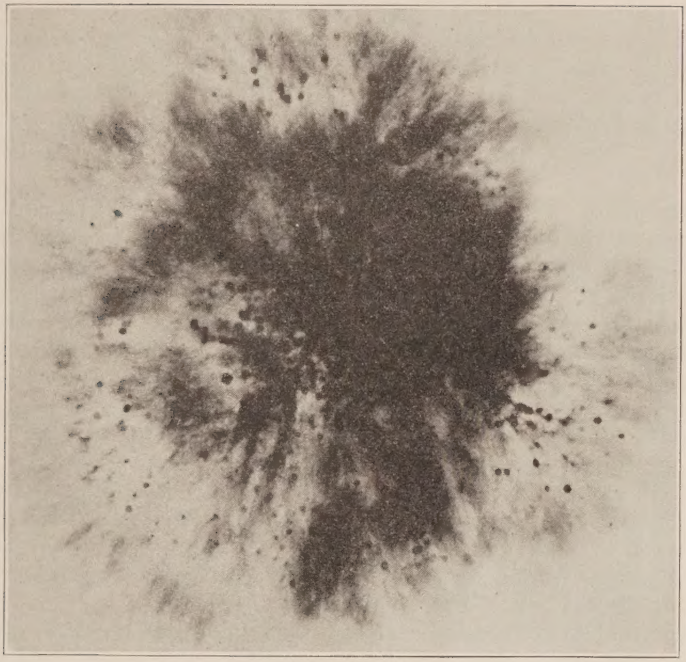

FIG. 18.—A SINGLE COLONY OF THE PHYLLOSTICTA ON CORN-MEAL AGAR

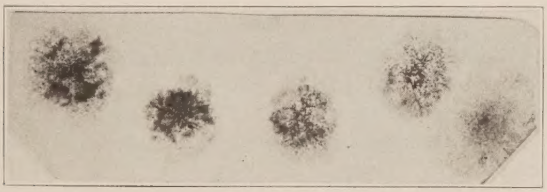

FIG. 19.—PORTION OF PETRI DISH SHOWING SEVERAL COLONIES OF THE PHYLLOSTICTA

larged view of a single spot, shows the numerous pycnidia. These are approximately circular, tan colored, about 120 to 150 μ in diameter, with an ostiole 20 to 30 μ wide (Fig. 14). Under appropriate conditions the spores issue in cirrhi or long agglutinated coils. From the leaf spot the spores are rather large for a Phyllosticta (10 to 19 μ by 4 to 5μ), and oblong (Fig. 15) and straight or very slightly curved. Specimens from the petiole and from some cultures to be described later gave a much smaller type of spore, as small as 4 to 5 μ by 1.5 to 5 μ (Fig. 16).

Isolation

The fungus was isolated on corn-meal agar in all of the ways noted on page 301, and with the same general results; i.e., the fungus grew readily and normally in culture (Fig. 17). Photographs of plates and colonies are given in Figs. 17, 18, and 19.

Culture Characters

On plates on corn-meal agar, the fungus grows rapidly and produces pycnidia quickly. When thickly sown, sporiferous pycnidia are produced in thirty-six hours; when more thinly sown, pycnidia are not so quickly produced. The colonies eventually become quite dark in the central region. The pycnidia arise uniformly by the simple meristogenous method. There is in corn-meal agar a very remarkable change in spore size from that exhibited by the same fungus when in its natural habitat. On this medium the spores are very rarely as long as 7 μ (Fig. 16). In very old cultures spores of somewhat larger size are found, but none as large as on the original leaf spots. On various autoclaved vegetable plugs the fungus grew well and formed numerous pycnidia normally. As with the Colletotrichum, Tropœolum stems were the most favorable medium. On cabbage the growth was exceptionally white. On rice the whole culture became black and was nearly like that of Colletotrichum (cf. Fig. 9).

The conidia germinated readily in hanging drops of water, nearly every spore germinating. There were formed no appressoria such as were invariably formed under similar conditions by the Colletotrichum.

TAXONOMY

Regarding this as a Phyllosticta and its spore measurements to be the extremes noted above; i.e., 4 to 19 μ by 1.5 to 5 μ, there are 829 species[1] listed by Saccardo from which, on a basis of spore size, it would be indistinguishable. Accepting the narrower limits of spore measurement obtained from the large spored forms from foliar material; i.e., 10 to 19 μ by 4 to 5 μ, there are 48 species listed by Saccardo from which it could not be distinguished by spore measurements. One only of these, however, occurs on any of the Polygonaceae. Ten other species of Phyllosticta are listed by Saccardo on Polygonaceae, but none of these has spores as large as the large-spored form described in this paper. All of these, with the exception of one, have maximum lengths of 12 μ, while in most of them the maximum length is below 8 μ. The one large-spored species, *P. straminella* Bres., described on *Rumex acestosa*, is given as having spores 12 to 20 μ long and is sufficiently close in morphology to the form under consideration to be regarded as the same species.

[1]These facts are taken from a tabulation of the species of Phyllosticta listed by Saccardo, prepared for future publication by Mrs. E. Young True.

XXV. Celery.—The cultivation under field conditions, at the hilling-up or banking stage.